NATIONAL AERONAUTICS &
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GLENN RESEARCH CENTER

GRC Current Task Overview
Solar Power Generation

Design & Operation of High Voltage Thin-Film Solar Arrays

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Design & Operation of High Voltage Thin-Film Solar Arrays

Background:

Thin-film solar arrays offer the potential of light weight, low cost, low stowed volume necessary for very high power systems. High voltage operation (~ 1000 volts) is critical to minimize mass and increase system performance.

High Voltage Operation:

Current space solar arrays operate ≤ 100 V (160 V for ISS). Numerous problems have been associated with solar array interaction with the space plasma. Environmental interactions with thin film solar arrays is unknown.

Solar array arcing under simulated space conditions.

Task Objective:

Preliminary assessment of operation of thin-film solar arrays at high voltages within the space environment. Investigate and quantify modifications necessary for high voltage operation.

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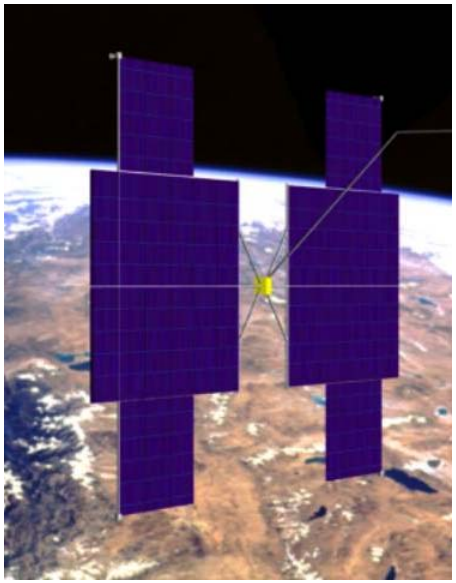
Able Engineering solar array study has shown that high voltage operation (~300 volts) is critical to maintain system performance even at "lower" power levels (50-100 kW).

- Harness mass significant on lightweight arrays
- Structure mass increases to maintain array dynamics
- Monolithic interconnection of thin-film cells needed
- Coatings required for thermal properties
- Micrometeoroid/debris impact must be addressed



Air Force Powersail concept for high power thin-film solar arrays.

Benefits of HV Thin-Film Task:

- Reduce wiring mass and associated structural mass
- Simplify power management and distribution requirements
- Enable high voltage operation under varying space environmental conditions
- Guide thin-film solar cell research towards technology that optimizes system -level performance
- Task results applicable to other programs and technologies (non-thin film)

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Research Approach:

- Obtain representative thin-film PV samples/coupons
  - Various cell types (CIGS, α Si, etc.)
  - Various cell substrates (polyimide, metallic, PBO, etc.)
  - Various interconnect schemes (individual cell interconnects, monolithic integration)
  - Various coating materials and thickness
- Modify coupons to minimize arcing under a space plasma environment
- Perform laboratory high voltage testing under simulated space conditions
- Evaluate applicability of modifications for SSP program

Plasma Interaction Facility (PIF) at NASA GRC used for testing solar array samples under space environmental conditions.

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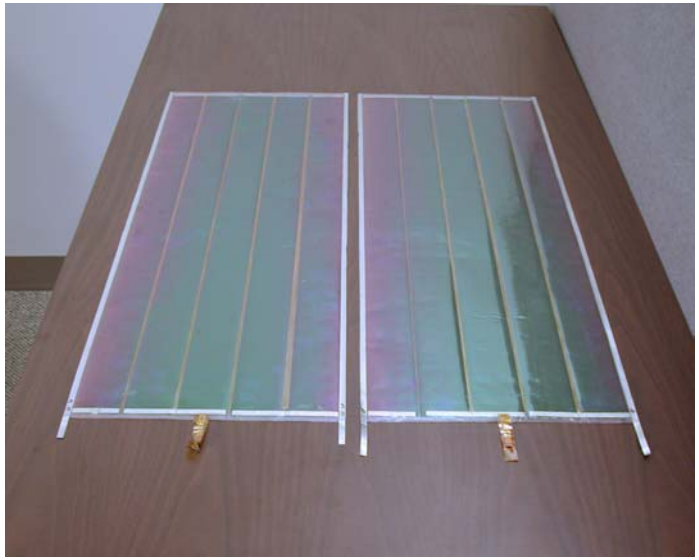
Task Status:

- Modifications to PIF facility completed
- Delays encountered in obtaining representative thin-film samples
- Sample preparations in progress (in-house, Air Force, cell & array vendors)
- CIGS high voltage blanket tested
  - Cells isolated from space plasma using transparent, insulating thin films
  - Trapped air discovered during vacuum pump-down
  - Initial test results inconclusive



High voltage (500 volt) CIGS thin-film blanket.

Future Plans:

- Prepare interim report on findings to-date
- Continue testing of samples as they become available (Oct.- Dec.)
- Investigate effects of micrometeoriod impacts on high voltage operation
- Test monolithically-integrated interconnect & cell coating technology
- Investigate alternative arc-mitigation techniques